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Involuntary Memory and Conceptual Priming

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Involuntary Memory and Conceptual Priming

Emma P. Petersen

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Abstract

The current study aimed to investigate the relationship between involuntary memory and conceptual priming. Conceptual priming is priming that revolves around personal concepts like people and places. Two forms of conceptual priming were examined: immediate conceptual priming and delayed (24 hour) conceptual priming. First, participants were instructed to recall specific memories in a priming activity. After, they engaged in a vigilance task. Participants in the immediate group engaged in the vigilance task immediately after completing the priming activity, whereas participants in the delayed group engaged in the vigilance task 24 hours after completing the priming activity. An independent judge determined whether memories in the vigilance task contained content from the priming activity. If there was similar content, it was considered a "hit." Results showed that memory frequency did not differ among groups, which aligns with previous research in this area that suggests priming influences memory content, not memory occurrence. The proportion of total hits to total memories recorded was insignificant, but the proportion of specific memory hits to total hits recorded was significant. This finding supports several theories in memory research including the existence of an episodic memory network, as well as the idea of conceptual association dominance. Future studies should continue to explore the effect duration of conceptual priming, considering 24-hour conceptual priming yielded significant priming effects.

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Voluntary and Involuntary Memory

Voluntary memory is intentional memory, meaning that it occurs upon deliberate retrieval (Berntsen, Rasmussen, Miles, Nielsen, & Ramsgaard, 2017). Deliberate retrieval tends to occur after direct prompt or instruction (e.g., recall an event from the past), but it can also occur if a memory needs to be recalled for the sake of an everyday task or conversation (Kamiya, 2014). It is consequently suggested that voluntary memory is controlled by human decision and ability; voluntary memory occurs under the conscious control of a human being. In sum, individuals are aware of both the retrieval and the experience of voluntary memories as they occur.

Voluntary memories serve many purposes in day-to-day life: the self-function, the social function, and the directive function (Kamiya, 2014). The self-function provides an individual with a sense of self and an understanding of his or her characteristics. The social function develops both intimate and casual relationships. The directive function allows an individual to plan accordingly for present and future endeavors. In other words, having the ability to deliberately remember things, whether upon request or requirement, is necessary to function adequately in today's society (Kamiya).

In contrast, involuntary memory is unintentional memory, meaning that it occurs without deliberate retrieval (Berntsen et al., 2017). Although involuntary memory is frequently considered an automatic process, it is experienced with conscious awareness (Mace, 2008). Individuals tend to experience involuntary memories when they are bored, relaxed, or daydreaming, but that is not always the case (Rasmussen, Ramsgaard, &

Berntsen, 2015). Regardless, the nature of involuntary memories is captivating and continues to stimulate the curiosity of cognitive psychologists.

Involuntary memories are argued to serve two major functions (Mace, Atkinson, Moeckel, & Torres, 2011). The first is an adaptive function; the second is an identity function. The adaptive function provides relevant information at the time of recall. With this information, an individual can adapt more fluidly to circumstances, conversations, or conditions. The identity function, like the self-function, provides information regarding the self-concept. Like voluntary memories, involuntary memories play an important role in an individual's ability to understand themselves and the people around them.

The distinction between voluntary and involuntary memory is not to be confused with the distinction between consciousness and unconsciousness (Mace, 2008). Both voluntary and involuntary memories occur in the realm of consciousness, just at varying capacities. Voluntary memory occurs in complete consciousness, considering it is under conscious control. Involuntary memory, on the other hand, occurs in relative consciousness; although involuntary memories are automatic, individuals who experience them are aware that they occurred.

It is important to emphasize the prior intention which separates voluntary memory from involuntary memory (Mace, 2010). Specifically, prior intention is present when a memory is voluntarily recalled, whereas prior intention is absent when a memory is involuntarily recalled. Again, this is often dependent on whether instructions to recall were given.

When an individual is voluntarily remembering something, he or she is said to be in what is called 'retrieval mode.' When an individual is in retrieval mode, both cues and memories are processed differently when instructions to retrieve are given (Barzykowski & Niedźwieńska, 2016). This explains the difficulty of capturing involuntary memories as they occur in real time. Researchers need participants to record their involuntary memories (in order to investigate them), but how can they do it without providing instruction? Finding a balance between deliberate instruction and soft suggestion is one of the difficulties of involuntary memory research, but it is nonetheless important to consider and incorporate.

Relation to Clinical Symptoms

Involuntary memory is a phenomenon scattered throughout clinical symptomology. For example, individuals with posttraumatic stress disorder (PTSD) report intrusive thoughts; individuals with obsessive-compulsive disorder (OCD) report obsessive thinking. It is therefore concluded that involuntary memories most likely play a role in mental disorder, mood, and general well-being (Barzykowski & Niedźwieńska, 2016).

Kvavilashvili and Schlagman (2011) wanted to examine the relationship between mental well-being and the occurrence of involuntary memories. Unlike most research in this area, which focuses exclusively on involuntary memory in dysphoric, or depressed, populations, this study investigated involuntary memory in both dysphoric and non-dysphoric populations. Dysphoric individuals experience more vivid and more intrusive involuntary memories than non-dysphoric individuals do (Kvavilashvili & Schlagman, 2011). Dysphoric individuals tend to suppress unwanted memories and avoid triggers that

may cause such memories to surface. In contrast, non-dysphoric individuals experience involuntary memories less intrusively and less frequently (Kvavilashvili & Schlagman). They are more likely to experience involuntary memories while engaging in mindless activity (e.g., talking a walk), as opposed to when encountering a trigger.

In the Kvavilashvili and Schlagman (2011) study, participants completed the Beck Depression Inventory (BDI) to assess mood, a vigilance task to assess involuntary memory activity, and a memory questionnaire to assess memory content. As expected, the pleasantness of memories was rated significantly more negative in dysphoric individuals than in non-dysphoric individuals (Kvavilashvili & Schlagman, 2011). Dysphoric individuals also seemed to be unable to use the same strategies when it came to understanding repetitive and intrusive memories as non-dysphoric individuals were able to use (Kvavilashvili & Schlagman).

Although this study focused exclusively on depression, it highlights the importance of understanding the mental health, and the corresponding mental ability, of study participants before examining involuntary memory, or any psychological phenomena for that matter; mental disorder can affect an individual's ability to perform as expected (baseline performance) in a study. Regardless, clinical symptomology can reveal information regarding involuntary memory frequency and content.

How Common Are Involuntary Memories?

Prior to the past several years, involuntary memories were considered less common than their voluntary counterparts. Voluntary remembering was assumed the standard, and most frequent, way of recalling autobiographical events, whereas

involuntary remembering was assumed an unusual and sporadic way of recalling autobiographical events (Rasmussen et al., 2015). Involuntary memories were also commonly associated with stress and trauma. They were even considered pathologically normal responses to negative circumstances or conditions (Rasmussen et al.).

As research in this area has advanced, studies suggest that involuntary memories are at least as frequent as, if not more frequent than, voluntary memories in young adults (Berntsen et al., 2017). Specifically, involuntary memories are three times as frequent in daily life as voluntary memories are. It is important to note, however, that frequency data collected from research is often dependent on study methodology (the methods used to obtain the data) (Rasmussen et al., 2015).

Consequently, Rasmussen et al. (2015) wanted to not only replicate the frequency baseline established in research (three times as frequent), but also explore different methodologies and their corresponding frequencies. Original frequency data was collected using online recordings (e.g., a mechanical counter), so unsurprisingly, the research team first replicated this.

Once the data was successfully replicated, they implemented a different procedure to assess frequency. Instead of using a mechanical counter (finger-activated counter that fits in the palm of a hand), participants were given a smartphone (HTC Wildfire android operating system, programmed with an android survey app) to count/track their voluntary or involuntary memories. Fifty undergraduate students participated in the study, 25 of which were instructed to detect involuntary memories, and 25 of which were instructed to detect voluntary memories. Age and gender was evenly distributed amongst the two groups/conditions.

Unexpectedly, individuals reported fewer involuntary memories when using a smartphone to record as opposed to a mechanical counter. However, individuals reported slightly more voluntary memories (Rasmussen et al., 2015). It was concluded that smartphones are more cumbersome and less convenient than mechanical counters when it comes to recording memories (the smartphones had to be unlocked in order to record a memory), which ultimately verified that the frequency of involuntary memories are dependent on study methodology.

Why Do Involuntary Memories Occur?

The underlying questions become how and why involuntary memories occur. Previous research has established that there are multiple ways in which unintentional memories pop-up in everyday thought. Direct involuntary remembering suggests that a single memory is triggered by cues (Mace, Clevinger, & Bernas, 2013). Cues are thoughts, words, sensory and/or bodily experiences (e.g., smell or feeling cold). For example, if an individual hears the word coin, he or she may remember a time that they had to make a purchase using only quarters and dimes. Likewise, if an individual feels cold, he or she may remember a time that they were locked out of his or her house in the winter.

Mace (2004) examined cue content and cue prevalence more thoroughly. He was interested in whether cues more commonly came from abstract experiences (e.g., language and thought), from concrete sensory/perceptual experiences (e.g., sight), or from bodily state experiences (e.g., feeling pain). He had participants record any involuntary memories they experienced throughout a 14-day period. In addition to recording the time and content of the involuntary memory, they were instructed to

determine where the involuntary memory came from. It was found that 68% of the recorded involuntary memories derived from abstract experiences, 30% from sensory/perceptual experiences, and only 2% from bodily state experiences. This data goes against common notion that sensory/perceptual experiences elicit involuntary memory most often (the Proustian view).

In contrast to direct involuntary remembering, chained involuntary remembering suggests that when a memory is retrieved, one or more additional memories quickly and uncontrollably occur afterwards. A single direct memory could elicit another memory, and that memory could elicit another memory, hence the term chaining (Mace et al., 2013). Memories can activate other memories in a sequence-like pattern within seconds; chained involuntary remembering is a far faster process than direct involuntary remembering.

It is important to note that memory activations within a memory chain tend to flow in the direction of many different memories, not inside of the same memory (e.g., elaborating on a memory, receiving more details regarding a memory, etc.) (Mace et al., 2013). Likewise, memory chains are never comprised of unrelated memories, although sometimes it may seem like it; whether an individual is consciously aware of it, associative patterns are the framework of memory chaining (Mace et al.). These associative patterns fall into one of two categories: general-event associated memories or conceptually associated memories (Mace et al.). In general-event associations, memories stem from the same general event period (e.g., night at a concert), whereas memories from conceptual associations stem from shared content (e.g., frequently involve the same people and places).

Mace et al. (2013) wanted to examine further the differences between general-event associated memories and conceptually associated memories. Consequently, they conducted an experiment that aimed to answer four questions which were (1) how the distribution of general-event related memories and conceptual memories may change with time or memory age; (2) what associative patterns exist for chains containing three or more memories (the majority of chains contain only two memories); (3) how representative involuntary memory chains are of the organization of autobiographical memories; and (4) how associations differ between general-event related and conceptual memories (although differences have been identified, they have never been examined in a qualitative or quantitative fashion).

In the first diary design, participants were given a pocket-sized diary that contained 50 pages, one page for each memory entry. Each page had five open-ended prompts/questions that participants were instructed to respond to: (1) a description of the memory; (2) a description of the retrieval cue; (3) their age in the memory; (4) the thoughts they had right before the memory; and (5) the activity that they were engaged in when the memory came to mind. Additionally, they were told to record the day and time that the memory had occurred.

In the second diary design, participants were given the same materials and instructions, however, there was additional work they had to complete; they had to rate the characteristics of the memories they experienced (each characteristic was rated on a different Likert scale): (1) vividness of the memory image; (2) feeling of being brought back or reliving an event; (3) usualness of an event; (4) memory occurrence; (5) an

event's importance; and (6)/(7) degree of emotion contained in a memory or during the retrieval of a memory.

Of the 130 diaries (130 participants), only 15 did not yield any involuntary memory chains. In total, participants recorded 406 involuntary memory chains, 99% of which had the same time entry (a memory occurred immediately after another memory). Of the 406 chains, 280 (69%) contained two memories, 80 (20%) contained three memories, 31 (7%) contained four memories, and the remainder contained 5-8 memories. Most significantly, no differences between chained involuntary memories and unchained involuntary memories were detected in the characteristic scales. These findings suggest that associations in involuntary memory chains are similar to the organization of memories in the autobiographical memory system (Mace et al., 2013).

Involuntary Memory Chains, Event Cueing, and Memory Organization

Event cueing is a voluntary memory sequencing procedure that was specifically created to investigate the organizational framework of autobiographical memory (Mace, Clevinger, & Martin, 2010). Typically, participants are instructed to recall autobiographical memories in response to word or phrase cues, and after doing so, are instructed to go back and recall one related autobiographical memory for each original autobiographical memory. There are no instructions/restrictions given to participants regarding how the original memory and the related memory are to be connected.

Event cueing has given insight to autobiographical memory organization, similar to how involuntary memory chains have. However, event cueing and involuntary memory chaining yield discrepant findings. Specifically, event cueing procedures have

shown that general-event associations are most common (occurring 60% to 70% of the time), whereas involuntary memory chains suggest that conceptual associations are far more prevalent (occurring approximately 80% of the time) (Mace et al., 2010). Consequently, Mace and colleagues (2010) conducted a study to investigate which form of association provides a more accurate representation of autobiographical memory organization.

Participants were distributed between three groups: (1) a long-list condition containing 18 cues; (2) a short-list condition containing four cues; and (3) an involuntary memory diary condition. Participants who engaged in event-cueing tasks (conditions one and two) were instructed to respond to phrase cues presented on a sheet of paper. After, they were told to go back and recall one related memory for each original memory they responded with. Participants who engaged in the involuntary memory diary recording (condition three) were instructed to record each and every involuntary memory they experienced over a period of two weeks, obviously after receiving vivid lecture on differences between involuntary and voluntary memories (all participants were able to distinguish the differences prior to the recording process).

It was found that memory production responses cause overestimates of general-event association, which Mace and colleagues originally hypothesized (Mace et al., 2010). They ultimately concluded that data from involuntary memory chains provide a clearer picture of the organization of autobiographical memory than event cueing procedures do (Mace et al., 2010).

Can Voluntary and Involuntary Memories Occur Simultaneously?

Involuntary memory retrieval has the potential to occur during voluntary memory retrieval. In other words, during of the process of retrieving a memory voluntarily, an individual may also encounter an involuntary memory. German psychologist Hermann Ebbinghaus (1850-1909) was among the first to examine this notion. He posited the existence of two types of conscious memory; one occurred after willful direction (voluntary), the other occurred without willful direction of any kind (involuntary). Ebbinghaus insisted that when an individual willfully remembers something, random thoughts or memories could 'pop-up' during the process. This logic falls under the category of memory chaining, which is a well-established reason for involuntary memory occurrence during involuntary recall, but not necessarily during voluntary recall (Mace, 2006). Consequently, Mace (2006) conducted a study to examine involuntary memory occurrence during voluntary recall. He found that they also occur in a chain-like pattern.

Priming

Priming is another explanation for involuntary memory occurrence. It is a phenomenon that is well understood and heavily researched in the psychology field. Priming occurs when an initial stimulus affects a response to a later stimulus. For example, if the word "nurse" was an initial stimulus, recognition of the word "doctor" would be quicker than the recognition of the word "sky." In this example, exposure to the word "nurse" influenced the recognition speed of words (the later stimulus). Substantial research has been published that examines the relationship between involuntary memory and priming. This research has played an important part in how implicit memory, semantic memory, and other extensions of memory are understood today (Mace & Clevinger, 2013).

Lifetime period priming. Lifetime period priming refers to priming that is centered on a specific period of time. When individuals undergo lifetime period priming, they are typically instructed to reminisce about a particular time in their life. This particular time can be a generic reference (e.g., being in college), or a specific reference (e.g., senior year of high school). Research suggests that individuals who deliberately reminisce about a particular period of time are more likely to experience involuntary memories regarding that period of time than individuals who do not deliberately reminisce (Mace, 2005).

Mace (2005) conducted three experiments that examined lifetime period priming. In the first experiment, participants recorded involuntary memories that they experienced over the course of 14 days in a diary. They were instructed to record a description of the memory, a description of the retrieval cue, a description of the previous thought, and a description of the previous activity. After the 14-day recording period, participants completed a 'preoccupation' questionnaire, which assessed their cognitive activity throughout the 14-day recording period. It was found that participants who indicated frequent thought about a life theme (e.g., significant others) on the questionnaire showed significantly more involuntary memories related to a life theme than those who were in the control group. This result suggests that involuntary memories may be primed by cognition (e.g., thinking about significant others). Unfortunately, causality could not be established given the correlational nature of the findings, so the next/other two experiments in the study used an experimental manipulation to assess priming.

In the second experiment, 12 participates similarly reordered any involuntary memories they experienced in a diary for 14 days. Halfway through the recording period

(approximately 7 days through), participants were advised to recall high school memories in the lab for 30 minutes. In other words, high school was the lifetime period in which Mace was attempting to prime experimental participants with.

In the third experiment, 24 participants similarly recorded any involuntary memories they experienced over the course of 14 days. There were 12 students in a one-year recall group and 12 students in a 13-16 (age range) recall group. They were advised to recall memories from their assigned lifetime period group in the lab for 30 minutes, four times throughout the 14-day journaling period. To clarify, this experiment primed participants with general lifetime periods, whereas the second experiment primed participants with very specific lifetime events of high school.

Ultimately, both the second and the third experiment yielded significant priming effects in the involuntary memories of participants for all of the lifetime periods primed. Consequently, it can be concluded that priming, concerning a specific period of time, potentially plays a significant role in the production of involuntary memories that individuals experience on a daily basis.

Disadvantages of diary studies. Unfortunately, diary studies have their drawbacks. Although they clarify the nature of the involuntary memories in everyday life, diary studies fail to provide the precise frequency of involuntary memories. They also fail to accurately capture individual differences in involuntary memory experience (Kamiya, 2014).

First, involuntary memories tend to occur when individuals are in a mentally undemanding state (Berntsen, 2002), making it likely that noticeable differences in

involuntary memories experienced by individuals stem from demands as opposed to uniqueness (Kamiya, 2014). Second, involuntary memories are not always recorded, and when they are, the content recorded is not always reliable (Kamiya, 2014).

Lab manipulation of lifetime period priming. Consequently, Barzykowski and Niedźwieńska (2017) examined the priming effects of lifetime period but strictly in a laboratory setting. In their study, they were investigating the occurrence of 'spontaneous thought' or involuntary memory. Experimental participants were asked to reminisce about high school between two vigilance tasks, whereas control participants played simple games between the two tasks.

Results suggest that participants in the experimental group reported involuntary memories relating to high school periods more frequently during the second vigilance task than participants in the control group. Experimental participants also had a marginally higher number of high school memories in the second vigilance task compared to the first vigilance task with a medium effect size, but the within subjects effect was not significant in the control group. Additionally, priming enhanced the retrieval of more remote involuntary memories in the experimental group than it did in the control group.

The relationship between lifetime period priming and involuntary memory production is clearly established (Barzykowski & Niedźwieńska, 2017; Mace, 2005). When an individual is instructed to recall a specific time in their life, he or she is more likely to have involuntary memories about that specific time than an individual who was not instructed to recall. In sum, recall sessions that pertain to lifetime periods increase the likelihood of involuntary memory occurrence. Specifically, an individual is more likely

to experience an involuntary memory relating to a primed lifetime period than an individual who is not primed.

Semantic priming. Semantic priming refers to priming that is centered on the general knowledge individuals have. When individuals undergo semantic priming, they are typically instructed to think about well-known concepts or ideas (e.g., reading books, writing papers, pursuing careers, etc.). Research suggests that individuals who deliberately think about a familiar idea are more likely to experience involuntary memories regarding that familiar idea than individuals who do not (Mace, McQueen, Hayslett, Staley, & Welch, 2018).

In classical semantic priming, spreading-activation theories suggest that semantic memory is a system of interconnected nodes, where each individual node represents an individual concept (Anderson, 1983). In order to process a word, for example, the relevant node needs to be activated. This activation spreads to other, related nodes/concepts, which ultimately facilitates the subsequent processing of those contexts.

Mace and colleagues (2018) conducted two experiments that examined semantic priming. In the first experiment, 22 undergraduate students were primed with concepts (e.g., *summer*) in a familiarity task, which consisted of 35 words. In this task, participants were instructed to rate the words on how familiar he or she was to its meaning, using a 0-5 scale (0 indicating unknown meaning, 5 indicating very familiar meaning). Twenty-one undergraduate students, in the control group, did not engage in this familiarity task. After, they were given a word-cue voluntary autobiographical memory task, which consisted of 15 word cues. In this task, participants were instructed to use word cues (e.g., *mountain*) to recall specific personal experiences from their past that were related to the word cues.

It was found that primed participants experienced more autobiographical memories relating to concepts in the familiarity task than control participants experienced.

In the second experiment, participants were similarly primed with concepts (e.g., *summer*) in a familiarity task. After, they were given a measure of involuntary autobiographical memory, instead of a word-cue voluntary autobiographical memory task. This measure was a vigilance task that was conducted on a computer. Specifically, participants were instructed to identify vertical lines displayed on a computer screen, in a presentation of both vertical and horizontal lines. Additionally, they were instructed to record any unrelated thoughts (involuntary memories) they experience while detecting the vertical lines. It was found that primed participants experienced more autobiographical memories (relating to concepts in the familiarity task) than control participants experienced, further validating semantic priming effects. In sum, familiarity tasks that revolve around general concepts affect involuntary memory frequency. Specifically, an individual who is primed with general concepts is more likely to experience involuntary memories relating to those general concepts than an individual who was not primed.

Again, semantic memory is a system of many nodes. When one node is activated (in use), it causes other, related nodes to similarly activate, hence the term spreading-activation (Anderson, 1983). Spreading-activation theories are considered functional because the spread of activation occurs amidst related information that is likely relevant to the processing context (Mace et al., 2018). Consequently, memories that are activated within a particular processing context are potentially functional to that context. This suggests that the spread of activation extends to related autobiographical memories that

could also be potentially relevant to the processing context, which implicates classic semantic priming theories (Mace et al., 2018).

The Current Study

The current study aimed to examine the relationship between involuntary memory and conceptual priming. Conceptual priming is priming that revolves around people, places, activities, and things. Although substantial research has been published regarding lifetime period priming, which focuses on specific periods of time, and semantic priming, which focuses on general concepts, there was a lack of research that examined conceptual priming.

Conceptual priming focuses exclusively on personal concepts or ideas. Personal concepts are typically things that an individual values or distinctly remembers, like a special person or a unique place. Conceptual priming occurs when an individual thinks about a personal concept and subsequently experiences involuntary memories about that personal concept (that he or she originally thought about). Because these topics (people, places, activities, and things) are specific to individuals, specific personal memories (e.g., episodic memories) are most commonly used in this area of research to prime participants with. Although Mace and Clevinger (2013) established that prior activation of specific personal memories primed voluntary memory production, the same trend was never established for involuntary memory production. Consequently, the current study was necessary in order to determine if established conclusions regarding voluntary memory could similarly be extended to involuntary memory.

In sum, the main goal of the current study was to investigate the relationship between involuntary memory and conceptual priming, in attempt to determine the role prior activation of specific personal memories plays in involuntary memory occurrence. A secondary goal of the current study was to investigate the effect duration of conceptual priming, in attempt to determine how long prior activation of specific personal memories influences involuntary memory occurrence. Lastly, the current study examined the influence conceptual priming has on memory occurrence or frequency. Most research in this area suggests that priming affects memory content exclusively, not memory frequency, so the current study aimed to validate that finding but as it pertains to conceptual priming (Kamiya, 2014).

The current study examined two forms of conceptual priming: immediate conceptual priming and delayed (24 hour) conceptual priming. Participants in the immediate group engaged in a vigilance task immediately after completing a priming activity, whereas participants in the delayed group engaged in a vigilance task 24 hours after completing a priming activity. There was also a control group; participants in the control group did not complete the priming activity, they simply engaged in the vigilance task.

Hypotheses

Originally, I predicted that both the immediate and delayed priming conditions would experience more specific memories in the vigilance task than the control group would. In other words, I expected to see participants who received priming to generate a higher number of conceptual priming cues in the vigilance task than participants who did not receive any form of priming.

Method

Participants

Participants were derived from Eastern Illinois University's pool of undergraduate students who were enrolled in Introduction to Psychology. I used the research participation software, SONA, to make the current study available to students. Through SONA, they signed up to participate in the current study. I provided the title of the study, a brief description of the experimental protocol, and the time slots in which they could participate. Sixty-seven people participated in the current study. The age ranges of participants were between 18 and 61 years ($M = 23.86$, $SD = 7.83$). Participants were randomly assigned to one of the three groups listed below:

Immediate conceptual priming group. Twenty-three participants received immediate conceptual priming, meaning that immediately following the priming activity, they engaged in the vigilance task and recorded involuntary memories as they experienced them in a lab. The data collected from these participants helped me explore the main goal of the experiment, which was to investigate the relationship between conceptual priming and involuntary memory content.

Long-term (24 hour) conceptual priming group. Twenty-four participants received long-term (24 hour) conceptual priming, meaning that 24 hours after the priming activity, participants engaged in the vigilance task and recorded involuntary memories as they experienced them in a lab. The data collected from these participants helped me explore the secondary goal of the experiment, which was to investigate the relationship between long-term conceptual priming and involuntary memory content.

Control group. Twenty participants were part of a control group. In the current study, participants in the control group did not engage in the priming activity. By having a group of participants exclusively participate in the vigilance task, comparisons could be made regarding the reported memories of those in the experimental conditions.

Material

Schlagman and Kvavilashvili (2008) created a laboratory-based task that instructs individuals to detect infrequent target stimuli (vertical lines) presented on a computer screen. As individuals engage in this task, they are instructed to record any involuntary memories that come to mind in response to irrelevant words presented on the computer screen behind the infrequent target stimuli (vertical lines) (Kvavilashvili & Schlagman, 2011). The current study's vigilance task was entirely based on this procedure.

Specifically, participants identified vertical lines in a presentation of both vertical and horizontal lines. This presentation, of approximately 500 slides, was displayed on a computer screen via SuperLab (version 4.5) software. There were about 475 slides with horizontal lines, and only about 25 slides with vertical lines. Each slide was presented for 1.5 seconds on the computer screen for a total of 12 minutes and 30 seconds. Behind the line presentation on each slide, there was a random word phrase (e.g., spending time with family, going on a walk, etc.) displayed in the center of the screen regardless of the line orientation.

Experimental participants engaged in a priming activity before they engaged in the vigilance task. These participants were instructed to recall specific conceptual memories from their past (e.g., memories about people, places, activities, and things).

Fourteen phrase cues, as well as detailed instructions, were presented on a priming worksheet (see Appendix).

Procedure

Informed consent was attained from all participants who engaged in the experiment; participants reviewed the informed consent form and became familiar with the study's procedure, objectives, research purposes, and general risks. They were informed that they could withdraw from the study at whatever point they felt necessary without repercussion or consequence.

After signing the informed consent form, experimental participants engaged in a priming activity. First, instructions were introduced and clarified. Then, participants were instructed to respond to approximately 14 phrase cues. They were instructed to record their responses to the phrase cues in the space provided on the worksheet (see Appendix).

To clarify, participants in the control group did not engage in the priming activity. Participants in the immediate conceptual priming group *immediately* continued onto a vigilance task (described below). Participants in the long-term conceptual priming group came back to the lab 24 hours after completing the priming activity to engage in a vigilance task (also described below). It is important to note that the vigilance task was identical for all three conditions.

Participants sat in front of a computer screen and were instructed (by a person) to detect vertical lines as they appeared (on the computer screen). They were instructed to say "Yes" out loud when they saw vertical lines, and to ignore the word phrases displayed in the background. Participants were then told that they may experience

unrelated thoughts or memories (involuntary memories) as they identified the vertical lines. If an involuntary memory was experienced, participants were instructed to click the mouse. The task consequently paused, and an instructional prompt was displayed on the screen. The prompt reminded participants to write down (record) the memory in a booklet of lined paper that was provided to them, and the pause allowed participants to temporarily stop the vigilance task, giving them sufficient time to record.

Following the vigilance task, both experimental and control participants had the difference between general and specific autobiographical memories explained to them. After, they read through their booklet of lined paper and marked entries as either thoughts or memories, and for those marked memories, they were told to determine if they were general or specific in nature. Eventually, one independent judge analyzed content overlap amongst groups.

Once completed, all participants were debriefed. The debriefing statement included a summary of the day's activities, as well as an overview of the study's research purposes and contributions to the field.

Statistical Analysis

In order to confirm classification and gauge content similarity more generally, an independent judge (a graduate student attending EIU) categorized reported memories from the vigilance task. The judge first verified the distinction participants made between thoughts and memories, and then verified the distinction participants made between general and specific autobiographical memories. After verifying those distinctions, the judge determined which memories were consistent with the priming activity, and which

were unrelated (e.g., which recollections in the vigilance task consisted of conceptual cues from the priming activity). These occurrences of overlap were analyzed to determine if the relationship between conceptual priming/long-term conceptual priming and involuntary memory existed.

Results

A one-way analysis of variance was calculated on the total number of memories recorded by participants to determine if memory frequency varied between groups (see Table 1). At an alpha level of .05, this analysis yielded a non-significant effect, $F(2, 64) = 2.42$, $p = .09$, meaning no statistically significant differences regarding memory frequency were detected. This finding supports the notion that priming does not influence memory frequency, but rather memory content; all groups, regardless of priming's absence or presence, generated a not statistically different number of memories.

Another analysis was conducted on the proportion of total bits to total memories recorded (both general and specific memories). When a participant recalled a memory that included a priming cue, it was considered a "hit" (see total hit proportions in Table 2). An independent samples one-way analysis of variance was calculated on the total hit proportions shown in Table 2. At an alpha level of .05, this analysis yielded a non-significant effect, $F(2, 64) = .03$, $p = .97$, meaning that the proportion of total hits to total memories recorded was not statistically exhibited.

In order to understand this non-significant finding, the current study's priming conditions (both immediate and delayed priming) was further examined. If participants primarily recalled specific memories in the initial priming activity, it would logically

make sense to see an non-significant proportion of total hits to total memories recorded; if participants did not recall general memories in the initial priming activity, why would general memory hits appear in the vigilance task? Consequently, a judge coded items in the initial priming activity as either general or specific memories. Results conclude that 94% of items recalled by participants in the immediate priming group contained specific memories, and that 98% of items recalled by participants in the delayed priming group contained specific memories. Both of these percentages validate that specific memories were primarily recalled in the initial priming activity, which ultimately confirms that specific memory hits should have almost exclusively been generated in the vigilance task.

To examine potential differences between the immediate and delayed percentages mentioned above, a t-test was conducted. At an alpha level of .05, this analysis yielded a non-significant effect, $t(44) = 1.44$, $p = .16$, meaning that participants who received immediate priming ($SD = .11$) and delayed priming ($SD = .04$) recalled specific memories in the initial priming activity not significantly different from one another. It should also be noted that in the delayed priming condition, 24 of the 26 participants (92%) assigned to this condition returned, as scheduled, for the vigilance task 24 hours later.

A second independent samples one-way analysis of variance was conducted on the proportion of specific memory hits to total hits recorded, meaning that the number of hits that pertained to specific memories were compared against the total number of hits recorded (hits that included both general and specific memories, see specific hit proportions in Table 2). At an alpha level of .05, this analysis yielded significant findings, $F(2, 64) = 4.25$, $p = .02$, , $\eta^2 = .12$. Follow-up with Fischer's LSD statistic revealed that

higher proportions of hits occurred in the immediate and delayed priming conditions than in the control condition (LSD = .19).

Specifically, results showed that participants who were immediately primed (M = .63, SD = .28) had significantly higher proportions of specific memory hits than participants who were not primed (M = .43, SD = .38). Likewise, results showed that participants who received delayed priming (M = .71, SD = .29) had significantly higher proportions of specific memory hits than participants who were not primed (M = .43, SD = .38).

Discussion

Participants, regardless of the priming they received, generated a not statistically different number of memories in the vigilance task, which attests to the standardization of the current study's design. This finding, more significantly, confirms that conceptual priming does not produce a difference in sheer memory frequency, but rather a difference in memory content; the majority of priming research has already established this finding, so the current study simply verified a previous discovery but as it pertains to conceptual priming specifically.

The proportion of totals hits to total memories recorded was not significantly different between groups. This finding means that out of all general and specific memories recorded by participants in the vigilance task, there was a non-significant number of totals hits produced. However, it is important to note that during the initial priming task, participants were instructed to recall specific memories, not general ones.

Out of all memories recalled by participants in the initial priming activity, 96% of them were specific (average percentage between immediate (94%) and delayed (98%) conditions). In other words, only 4% of the memories recalled by participants in the initial priming activity were general memories. Therefore, it can be concluded that because participants were almost exclusively primed with specific memories, the proportion of total hits to total memories should have been non-significant (e.g., participants were not primed with general memories, so general memories should not have been produced in the vigilance task).

The proportion of specific memory hits to total hits was significantly different between groups, meaning that out of all hits recorded, specific memory hits held the majority. This finding supports the conclusion previously made; participants should have produced more specific memory hits than general memory hits in the vigilance task because they primarily recalled specific memories in the initial priming task.

As mentioned in the introduction, the reasons why involuntary memories occur are often debated in the memory literature. In the past, researchers assumed that involuntary memories were random and sporadic. However, lifetime period priming and semantic priming studies have confirmed that involuntary memories are not random and sporadic, but rather triggered by encountering cues and/or reminiscing (e.g., Mace, 2005; Mace et al., 2018). The current study established that conceptual priming, too, activates involuntary memory. Specifically, the memories participants recorded in the vigilance task were not random; the memories participants recorded in the vigilance task contained conceptual cues that were part of the initial priming activity. In other words, the more

participants reminisced about specific personal concepts, the more likely those specific personal concepts were to show up in their recollections during the vigilance task. In the current study, this notion was supported by the finding that specific memory hits in the priming groups were more likely to overlap with the primed content than the control group. It is subsequently confirmed that involuntary memories are not accidental and erratic, but rather systematic. Precisely, the more an individual reminisces about personal concepts, the more likely they are to experience involuntary memories that pertain to those personal concepts.

Another confirmation the current study made was regarding the long-term effects of conceptual priming. When compared against the immediate priming group, the long-term (24 hour) priming group experienced more specific memory hits, although this difference was not statistically exhibited. However, the differences in hits between conditions were trending towards significance. This trend shows that conceptual priming effects do not decrease after 24 hours, which ultimately supports the idea of priming (and involuntary memory occurrence) being cumulative in nature. Future studies should consequently explore conceptual priming effects 24+ hours after exposure to conceptual cues.

Until there is a decrease seen in the number of conceptual cues reported by participants in the vigilance task, the delayed priming condition needs continuous exploration. Whether a decrease occurs 48 hours after priming or an entire week after priming, important conclusions are still to be made. In determining how long conceptual priming lasts, researchers will be able to compare it with how long other kinds of priming

last (e.g., lifetime period priming, semantic priming, etc.). After making comparisons, they will be able to determine, most importantly, which cues impact people for the longest amount of time.

Unfortunately, there are experimental difficulties associated with extending the time between a priming activity and a vigilance task, some of which were encountered during the current study. A participant's commitment to the study can significantly contribute to his/her likelihood of returning to complete a vigilance task (after engaging in a priming activity). Likewise, outside variables including school and work schedules can interfere with a participant's ability to reminisce about cues outside of the lab. Consequently, the incentives given to participants to attend future studies that examine delayed priming need to supersede class credit or trivial monetary incentive.

The current study's results also have implications for the organization of memories in the autobiographical memory system. Specifically, the result that specific memory hits were produced by specific memory recollection aligns with theories that suggest specific (episodic) memories are networked separately from general autobiographical memories in the autobiographical memory system (Conway, 2005). This theory subsequently concludes that specific memory reminiscing should almost exclusively generate specific memories, and that general memory reminiscing should almost exclusively generate general memories.

Conway (2005) expanded further on this theory. He posited that the autobiographical memory system contains lifetime periods, general events, and specific episodic memory layers, all being connected vertically. Specifically, he suggested that

general forms compose the upper hierarchy of autobiographical memory organization and specific forms compose the bottom layers. Within each layer, memories are able to network and activate one another (Mace & Clevinger, 2013). This means that episodic memory priming should activate and produce other episodic memories, which would more thoroughly explain the current study's finding (e.g., participants were primed with specific memory cues, so they reproduced those specific memory cues in the vigilance task).

The ability episodic memories have to activate one another is either consciously or unconsciously recognized by the individual experiencing them (Mace, 2005). Regardless, these activations happen automatically. This notion verifies that there is a preexisting associative nature to episodic memories that exists without a priming manipulation. As mentioned in the introduction, three types of associations are seen in episodic memories: general-event associations, lifetime period associations, and conceptual associations. However, most literature, particularly research on involuntary memory chains, suggests that conceptual associations are the most common of the three types. Specifically, after an individual experiences more than two memories in an involuntary memory chain, the likelihood of the memories becoming conceptually associated (as opposed to maintaining general-event associations) increases dramatically, thus confirming their prevalence.

In the current study, the theory of episodic memories being conceptually networked was supported. Participants were primed with conceptual topics (people,

places, activities, and things), and that priming resulted in the production of other memories that contained conceptual content in the vigilance task.

The importance of establishing this trend (episodic memories' ability to activate one another) is highlighted when the nature of episodic memory is considered; when an individual recalls an episodic memory (e.g., merging onto an expressway), it may prompt an additional episodic memory (e.g., another instance of merging). This notion highlights the functional role episodic memories likely play in everyday life. More significantly, this notion emphasizes the importance of continuing to examine involuntary memory and conceptual priming, and the roles they may play in society.

In conclusion, the current study's results align with many established findings in memory research. First, there were no differences detected in memory frequency between groups. This result supports the notion that priming does not influence memory occurrence, but rather memory content. Additionally, it was found that the proportion of total hits to total memories recorded was non-significant. Through further investigation, it was discovered that this finding was non-significant because specific memories were primarily recalled in the priming activity, not general ones; if participants are reminiscing about specific memories during the priming activity, specific memories should almost exclusively be produced in the vigilance task. The proportion of specific memory hits to total hits was found to be significant. This finding supports several theories in memory research including the idea of there being a memory network dedicated solely to episodic memory. Specifically, research suggests that episodic memories are categorized independently (apart from other types of memories) in the autobiographical memory

system. Consequently, episodic memories should almost exclusively activate and generate episodic memories.

Lastly, future studies should continue to explore the effect duration of conceptual priming, considering 24-hour conceptual priming implemented in the current study only increased the production of involuntary memories. Until there is a decrease in the number of conceptual cues reported by participants in the vigilance task, the hours between the initial priming activity and the vigilance task need to increase at varying increments and be examined. However, it is important to note the difficulty in extending the time between the initial priming activity and the vigilance task; barriers and obstacles become increasingly difficult to troubleshoot, like a participant's commitment to the study, for example.

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Table 1. The frequency of memories experienced by participants in the control, immediate, and delayed groups.

Group	n	M	SD
Control	20	7.46	6.83
Immediate Priming	23	11.75	7.81
Delayed Priming	24	9.08	5.66

Table 2. The proportion of total hits to total memories recorded by participants, as well as the proportion of specific memory hits to total hits.

Group	n	M	SD
Total Hit Proportions			
Control	20	.43	.31
Immediate Priming	23	.45	.25
Delayed Priming	24	.44	.25
Specific Hit Proportions			
Control	20	.43	.38
Immediate Priming	23	.63	.28
Delayed Priming	24	.71	.29

Appendix

Remember a time when you were exercising.

Remember a time when you were with an aunt or uncle.

Remember a time when you were in a car.

Remember a time when you were listening to music.

Remember a time when you were with your brother or sister.

Remember a time when you were at a sporting event.

Remember a time when you were with your mother.

Remember a time when you were at a concert.

Remember a time when you were at school.

Remember a time when you were with a group of friends.

Remember a time when you were with a boyfriend or girlfriend (romantic relationship).

Remember a time when you were with a pet.

Remember a time when you were with a cousin.

Remember a time when you were with your father.